

We claim:

1. A method for laminating glass sheets, comprising:

placing laminating film over one surface of a first glass sheet;

heating said film with microwave radiation to a bonding temperature;

5 successively pressing areas of the heated film to said one surface in a continuous manner for purging air from between said film and said one surface and for applying bonding pressure;

cooling the pressed film areas whereby an appropriate bond is attained between said film and said one surface;

10 subjecting said first glass sheet with bonded film to a partial vacuum and positioning a second glass sheet on said film and pressing said second glass sheet to said film;

reheating said film with microwave radiation to a bonding temperature; and

cooling said reheated film whereby an appropriate bond is attained between said film and said second glass sheet.

15 2. The method of claim 1 wherein the step of placing laminating film over one surface of a first glass sheet includes fixing an edge of said film to a corresponding edge of said first glass sheet, and the step of heating said film is initiated at said fixed edge and continuously advanced therefrom over said film.

3. The method of claim 1 wherein said film is placed over said one surface with
20 a gap therebetween prior to successively pressing.

4. The method of claim 1 wherein the step of successively pressing is carried out with a non-stick applicator.

5. The method of claim 1 wherein the microwave radiation frequency is selected to be generally between approximately 0.9 GHz to approximately 200 GHz.

5 6. The method of claim 1 wherein the preferable microwave radiation wavelength is selected to be between approximately four optical thicknesses of said first glass sheet for the selected wavelength to approximately the sum of the thickness of skin layers in said film and said first glass sheet.

7. The method of claim 1 wherein heating of said film is provided by moving
10 a heat source over the film.

8. The method of claim 1 wherein the vacuum level is selected whereby remaining air in the laminate does not create visible defects.

9. The method of claim 1 wherein an additional electromagnetic heat source with a wavelength that is significantly shorter than the applied microwave radiation is used to reheat the
15 film.

10. The method of claim 9 wherein said additional electromagnetic heat source is selected from the group consisting of infrared, ultraviolet, laser and X-ray heat sources.

11. The method of claim 1 wherein the step of heating is carried out in a partial vacuum.

12. The method of claim 11 wherein the vacuum level is selected whereby remaining air in the laminate does not create visible defects.

5 13. The method of claim 1 wherein a reflector is positioned behind said first glass sheet at a distance equal to 0, 1, 2, 3 . . . multiplied by half wavelengths of the microwave radiation in a vacuum corresponding to the selected frequency.

14. The method of claim 13 wherein said reflector is at least in part supporting said first glass sheet.

10 15. The method of claim 1 wherein at least one combination of steps, selected from the combinations consisting of the steps of heating and successively pressing and the steps of reheating and pressing said second glass sheet, is performed simultaneously with an applicator tool comprised of materials transparent to microwave.

16. The method of claim 15 wherein the applicator tool material is selected from
15 a group consisting of Teflon, quartz and oxide ceramic.

17. The method of claim 1 wherein the vacuum level is selected to be no greater than one kPa.

18. The method of claim 1 wherein said areas of heated film are strips and successively pressing is accomplished with a roller.

19. The method of claim 1, after subjecting said first glass sheet with bonded film to a partial vacuum, stacking multiple of said first glass sheets with bonded film in the partial vacuum to provide a stack whereby non-coated surfaces of said first glass sheets engage the film bonded to an adjacent first glass sheet with one bonded film left exposed, the steps of positioning and pressing said second glass sheet being carried out on the exposed film of said stack, and the steps of reheating and cooling each being carried out on all film layers in said stack simultaneously.

20. The method of claim 19 wherein reheating is carried out on said bonded films of said first sheets prior to stacking.

21. The method of claim 19 wherein the microwave radiation frequency is selected such that the temperature variation of the stacked films does not exceed a predetermined level.